University of Hertfordshire UH

Analysis of EEG Microstates During Execution of a Nine Hole Peg Test

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Designation: PhD student in Computer Science.

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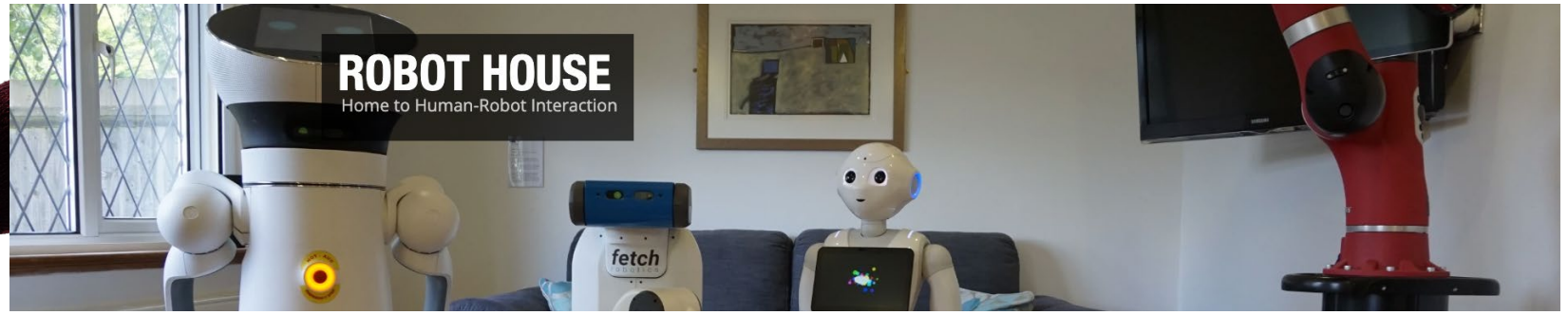
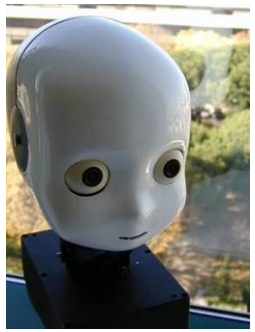
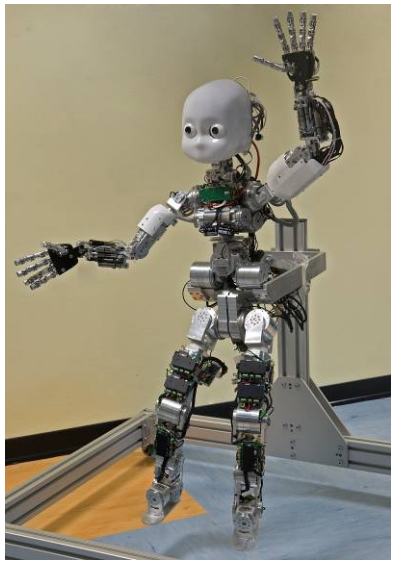
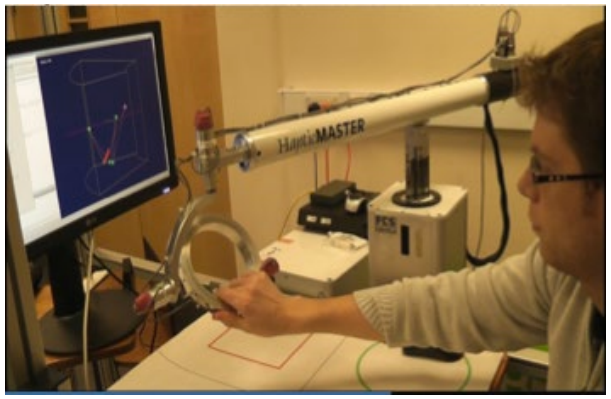
Areas of Interest: Rehabilitation Robotic, Human-machine interaction, Signal processing and Machine learning.

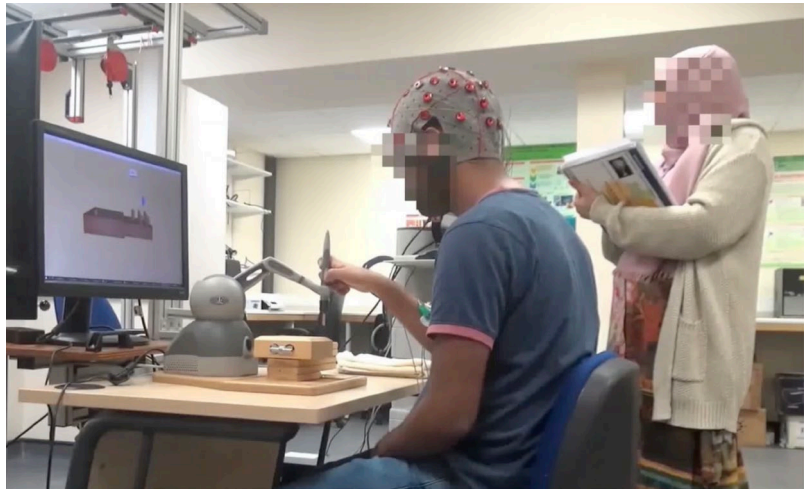




Robots in UH **Robot House** and Robotics Research Group





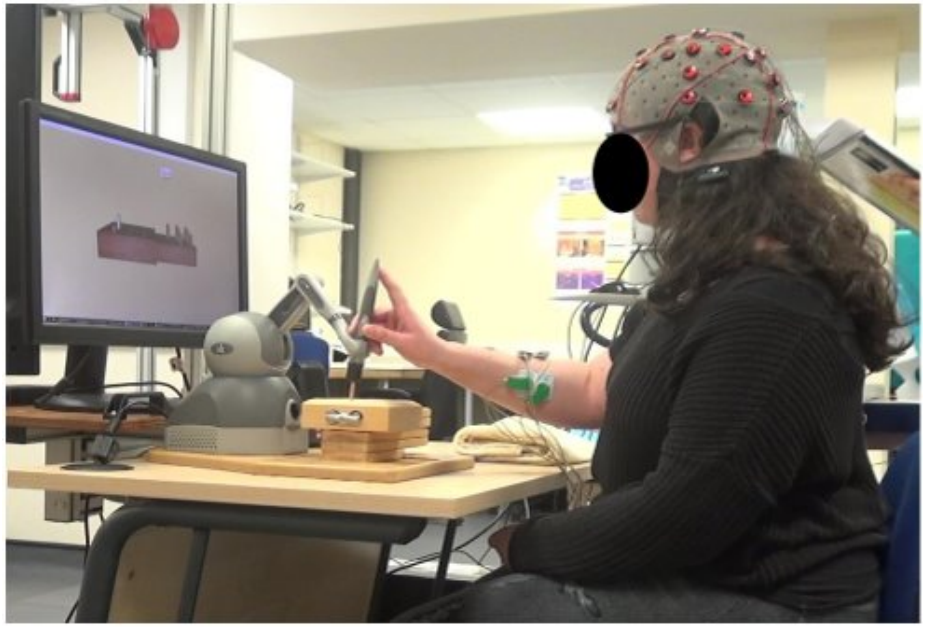


Overview

- Research Context
  - Rehabilitation of stroke patients
  - Neural correlates of fatigue
- Current work
  - Exploring alterations in Microstate parameters in the context of fatigue
- Hypothesis
  - To explore changes in neural assemblies related to resting state and fine motor state EEG under the influence of fatigue.

Experiment Setup

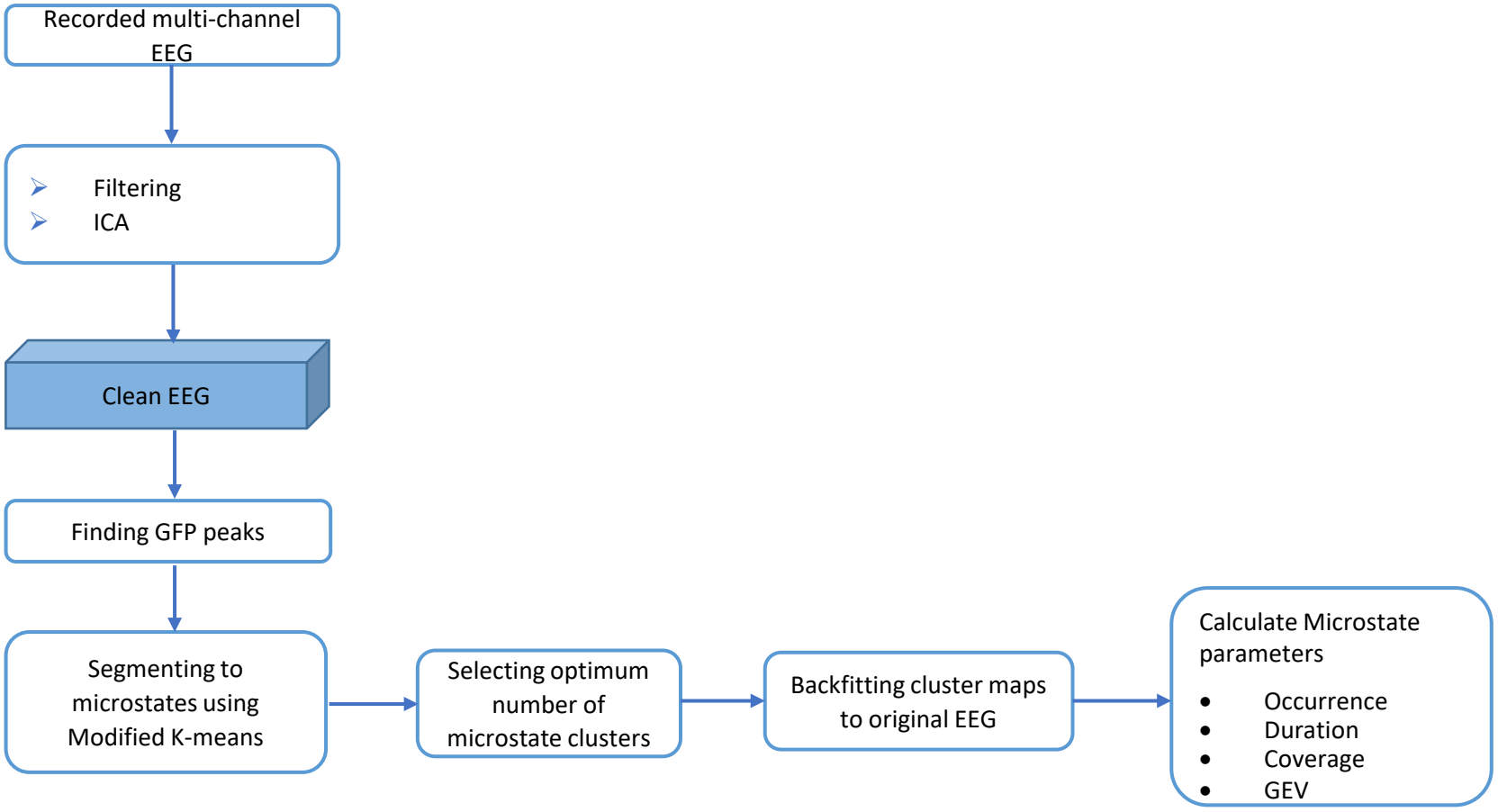
- Five healthy participants were recruited for the study.
- EEG signals from 16 electrode locations were collected.
- Geomagic Touch to provide an embedded reality set up.



Experiment Protocol

- Ethics approval - ECS/PGR/UH/04035.

Methodology



Flow diagram for microstate analysis

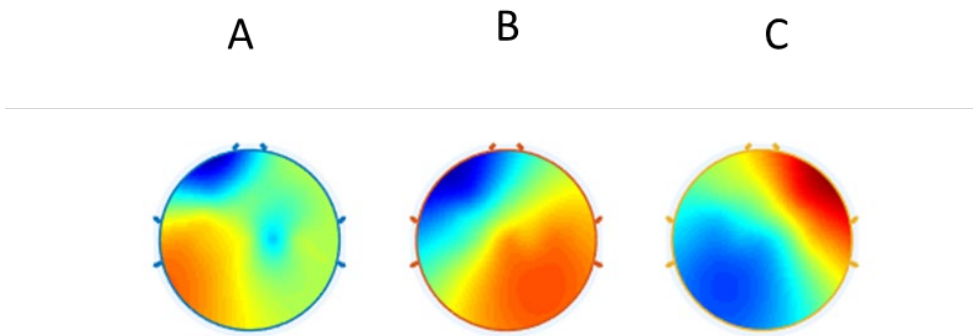
Methodology

Microstate Parameters

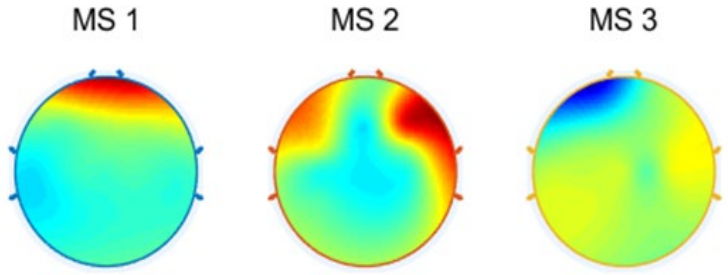
- Occurrence
- Duration
- Coverage
- Global Explained Varience

Results

Resting state Microstates



NHPT Trial Microstates



Resting state microstate parameters

Subject	Microstates	Occurrence			Duration(ms)			Coverage(%)			GEV		
		Pre	Post	Change	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
1	A	4.32	4.57	↑	78.34	150.32	↑	34	64	↑	0.17	0.36	↑
	B	4.12	3.10	↓	77.74	57.16	↓	32	18	↓	0.15	0.07	↓
	C	4.35	2.85	↓	80.18	61.47	↓	35	18	↓	0.19	0.08	↓
2	A	2.00	2.42	↑	49.68	54.79	↑	10	13	↑	0.03	0.03	
	B	4.72	4.45	↓	101.05	140.23	↑	47	60	↑	0.18	0.21	↑
	C	4.77	3.55	↓	92.85	76.75	↓	43	27	↓	0.17	0.07	↓
3	A	0.57	1.30	↑	40.00	44.26	↑	3	6	↑	0.00	0.01	↑
	B	4.20	4.60	↑	123.88	106.72	↓	48	46	↓	0.17	0.13	↓
	C	4.25	4.47	↑	119.89	119.71	↓	49	48	↓	0.18	0.15	↓
4	A	1.15	0.62	↓	72.49	30.90	↓	11	3	↓	0.02	0.01	↓
	B	2.37	3.57	↑	116.21	116.41	↑	27	41	↑	0.07	0.14	↑
	C	2.45	3.67	↑	402.22	165.44	↓	62	55	↓	0.25	0.25	
5	A	0.95	2.30	↑	47.18	64.40	↑	6	15	↑	0.01	0.03	↑
	B	2.75	3.75	↑	60.34	74.45	↑	17	28	↑	0.03	0.08	↑
	C	3.62	4.30	↑	233.95	145.44	↓	77	56	↓	0.32	0.26	↓

↑ and ↓ indicates increase and decrease of microstate parameters respectively

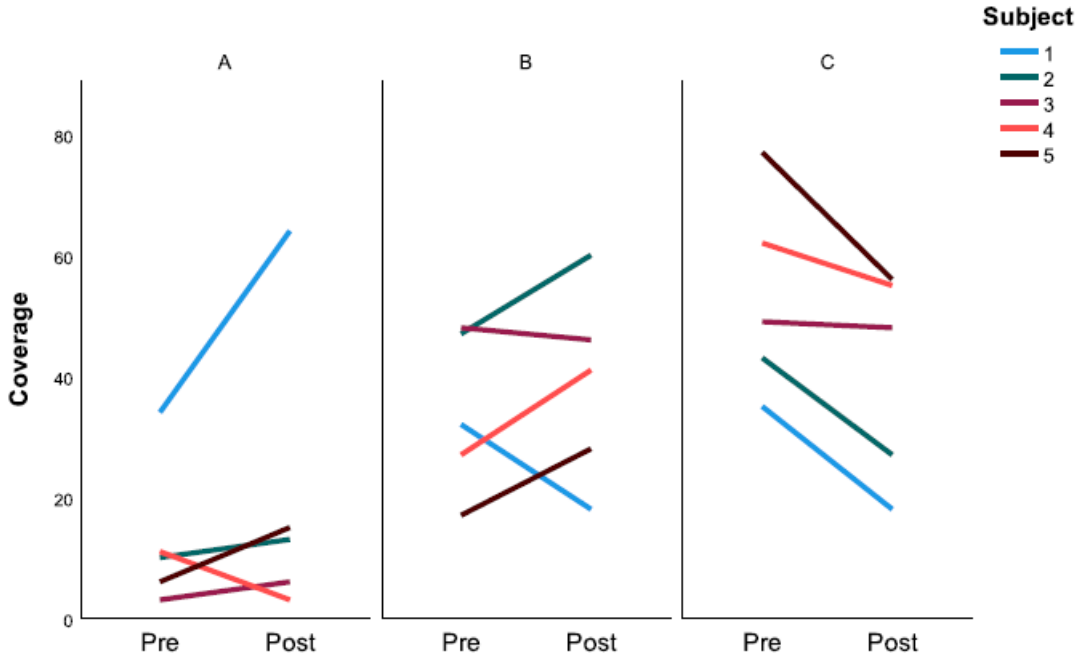
NHPT trial microstate parameters

Subject	Microstates	Occurrence			Duration(ms)			Coverage(%)			GEV		
		Pre	Post	Change	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
1	MS1	0.81	1.52	↑	78.89	65.56	↓	6.40	10.00	↑	0.0023	0.02	↑
	MS2	1.08	1.28	↑	48.96	61.98	↑	5.30	8.82	↑	0.0035	0.01	↑
	MS3	2.16	3.31	↑	409.69	266.01	↓	88.30	81.19	↓	0.63	0.38	↓
2	MS1	0.29	0.67	↑	3.46*	1.76*	↓	100	98.29	↓	0.69	0.81	↑
	MS2	0	0.33	↑	0	25.69	↑	0	1.72	↑	0	0.0011	↑
	MS3	0	0		0	0		0	0		0	0	
3	MS1	1.86	1.00	↓	492.02	975.00	↑	91.68	97.79	↑	0.81	0.87	↑
	MS2	0.53	0.50	↓	75.42	44.17	↓	4.02	2.21	↓	0.0023	0.0015	↓
	MS3	1.06	0	↓	40.42	0	↓	4.30	0	↓	0.0054	0	↓
4	MS1	2.67	2.62	↓	154.72	399.78	↑	42.45	73.67	↑	0.30	0.61	↑
	MS2	2.67	2.24	↓	258.64	102.69	↓	49.31	24.67	↓	0.33	0.07	↓
	MS3	1.00	0.25	↓	69.21	33.13	↓	8.23	1.66	↓	0.02	0.0007	↓
5	MS1	3.92	1.31	↓	189.08	703.75	↑	74.13	92.45	↑	0.41	0.75	↑
	MS2	1.18	1.31	↑	39.72	57.50	↑	4.67	7.55	↑	0.01	0.01	↑
	MS3	3.92	0	↓	54.08	0	↓	21.20	0	↓	0.05	0	↓

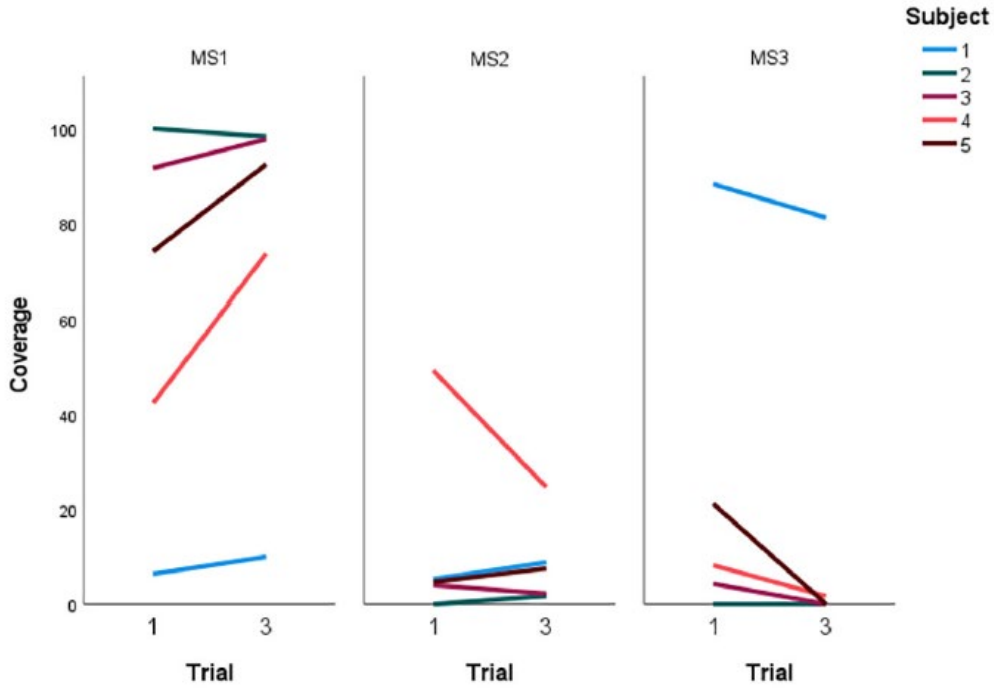
↑ and ↓ indicates increase and decrease of microstate parameters respectively

*Duration of MS1 for subject 2 is in seconds

Changes in coverage with fatigue



Coverage of resting state microstates pre and post fatigue



Coverage while performing NHPT

Performance time and fatigue status

Subject	Trial1	Trial2	Trial3	Trial4
1	67	58	78	67
2	90	118	127	102
3	53	49	46	37
4	114	86	79	69
5	96	62	47	55
Mean (SD)	84 (21.59)	74.6 (27.85)	75.4 (32.99)	66 (23.81)

Time taken for each trial of NHPT

Subject	Before Trial1	After Trial2	Before Trial3	After Trial 4
1	1	2	8	7
2	1	1	8	8
3	1	1	8	6
4	1	4	9	9
5	1	2	8	7

Self-reported Fatigue status

Conclusion

- Three distinct set of microstates are observed during the resting state and while performing the NHPT.
- Physical fatigue can be observed and identified by assessing changes in microstate features such as coverage.
- Increasing the number of participants will help in performing statistically valid analysis of findings.

THANK YOU